WHAT IS CLAIMED IS:

1. A method for monitoring protein synthesis in a protein synthesis system, the method comprising:

providing a marker for protein synthesis in the system, said marker being detectable through detection of electromagnetic radiation;

detecting electromagnetic radiation emitted from the system; and analyzing said emitted radiation to monitor protein synthesis activity in said system.

- 2. The method of claim 1 wherein the system comprises a bacterium or bacterial culture.
- 3. The method of claim 1 wherein the system comprises at least one cell.
- 4. The method of claim 3, wherein the system comprises at least one of a cell-line or a cell culture.
- 5. The method of claim 1 wherein the system comprises a cell-free protein translation system (*in-vitro* translation system).
- 6. The method of claim 1 wherein one or more of ribosomes, ribosomal RNA, ribosomal proteins, tRNAs, or amino acids in the system are artificially adapted to provide said marker.
- 7. The method of claim 1 wherein said marker comprises at least a portion of one or more of natural ribosomes, ribosomal RNA, ribosomal proteins, tRNAs, or amino acids.
- 8. The method of any of claims 1-7 wherein said marker comprises at least one photo-active component.

- 9. The method of any of claims 1-8, wherein said emitted radiation comprises radiation obtained by energy transfer between at least two of a plurality of components of the system.
- 10. The method of claim 9 wherein said marker comprises at least one fluorescent donor-acceptor pair.
- 11. The method of claim 10, wherein said emitted radiation comprises a FRET (Fluorescence resonance energy transfer) signal.
- 12. The method of any of claims 8-11 wherein said emitted radiation comprises a fluorescent signal.
- 13. The method of any of claims 8-12, wherein at least a portion of said marker comprises at least one of a fluorescent protein, a fluorescent dye, a quantum dot or a luminescent substance.
- 14. The method of claim 13, wherein said luminescent substance comprises a luminescent protein or portion thereof.
- 15. The method of any of claims 1-8, wherein said marker comprises a first portion being a fluorescent substance and a second portion for quenching said fluorescent substance.
- 16. The method of claim 15, wherein said detecting comprises detecting a reduction in emitted radiation.
- 17. The method of any of claims 8-16, wherein at least a portion of said marker is covalently or non-covalently bound to a tRNA.

- 18. The method of any of claims 8-17, wherein at least a portion of said marker is covalently or non-covalently bound to at least a portion of a ribosome.
- 19. The method of claim 18, wherein said portion of said ribosome is at or near at least one of the A site, P site, E site or peptide exit channel site.
- 20. The method of claims 18 or 19, wherein said at least a portion comprises an amino acid.
- 21. The method of any of claims 1-20 wherein said detecting comprises irradiating the system with electromagnetic radiation.
- 23. The method of any of claims 1-21 wherein said emitted radiation is detected with a microscope.
- 24. The method of any of claims 1-23, adapted to measure emitted radiation from a single ribosome.
- 25. The method of claim 24, wherein said marker comprises a donor-acceptor fluorescent pair suitable for performing single pair FRET and wherein said emitted radiation occurs upon performing single pair FRET.
- 26. The method of any of claims 1-23, adapted to measure signals from a plurality of ribosomes.
- 27. The method of claim 26, wherein said analyzing said emitted radiation comprises performing signal analysis of emitted radiation from said plurality of ribosomes.
 - 28. The method of any of claims 1-27, further comprising:

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identifying at least one protein being synthesized through said analyzing said emitted radiation.

- 29. The method of any of claims 1-28, wherein said detecting is performed in real time.
- 30. The method of any of claims 1-29, wherein said detecting further comprises:

monitoring protein synthesis by detecting a plurality of protein synthetic processes over a period of time.

- 31. The method of claim 30, wherein said plurality of protein synthetic processes comprise a plurality of interactions between a ribosome and a plurality of different tRNA molecules.
- 32. An apparatus for measuring protein synthesis by a protein synthesis system, said apparatus comprising:

a container for containing a plurality of components for the system, wherein at least one component is capable of emitting electromagnetic radiation due to a protein synthesis activity;

- a detection system to measure emitted radiation from the system; and a computational device to analyze said emitted radiation and determine the protein synthesis activity in said system.
 - 33. The apparatus of claim 32 wherein the system comprises a bacterium or bacterial culture.
 - 34. The apparatus of claim 32 wherein the system comprises at least one cell.

- 35. The apparatus of claim 34, wherein the system comprises at least one of a cell-line or a cell culture.
- 36. The apparatus of claim 32 wherein the system comprises a cell-free protein translation system (*in-vitro* translation system).
- 37. The apparatus of claim 32 wherein one or more of ribosomes, ribosomal RNA, ribosomal proteins, tRNAs, or amino acids in the system are artificially adapted to provide said marker.
- 38. The apparatus of claim 32 wherein said marker comprises at least a portion of one or more of natural ribosomes, ribosomal RNA, ribosomal proteins, tRNAs, or amino acids.
- 39. The apparatus of any of claims 32-38 wherein said marker comprises at least one photo-active component.
- 40. The apparatus of any of claims 32-39, wherein said emitted radiation comprises radiation obtained by energy transfer between at least two of a plurality of components of the system.
- 41. The apparatus of claim 40 wherein said marker comprises at least one fluorescent donor-acceptor pair.
- 42. The apparatus of claim 41, wherein said emitted radiation comprises a FRET (Fluorescence resonance energy transfer) signal.
- 43. The apparatus of any of claims 39-42 wherein said emitted radiation comprises a fluorescent signal.

- 44. The apparatus of any of claims 39-43, wherein at least a portion of said marker comprises at least one of a fluorescent protein, a fluorescent dye, a quantum dot or a luminescent substance.
- 45. The apparatus of claim 44, wherein said luminescent substance comprises a luminescent protein or portion thereof.
- 46. The apparatus of any of claims 32-39, wherein said marker comprises a first portion being a fluorescent substance and a second portion for quenching said fluorescent substance.
- 47. The apparatus of claim 46, wherein said detection system detects a reduction in emitted radiation.
- 48. The apparatus of any of claims 39-47, wherein at least a portion of said marker is covalently or non-covalently bound to a tRNA.
- 49. The apparatus of any of claims 39-48, wherein at least a portion of said marker is covalently or non-covalently bound to at least a portion of a ribosome.
- 50. The apparatus of claim 49, wherein said portion of said ribosome is at or near at least one of the A site, P site, E site or peptide exit channel site.
- 51. The apparatus of claims 49 or 50, wherein said at least a portion comprises an amino acid.
- 52. The apparatus of any of claims 32-51 wherein said detection system irradiates the system with electromagnetic radiation.
- 53. The apparatus of any of claims 32-52 wherein said detection system comprises a microscope.

- 54. The apparatus of any of claims 32-23, wherein said detection system measures emitted radiation from a single ribosome.
- 55. The apparatus of claim 54, wherein said marker comprises a donor-acceptor fluorescent pair suitable for performing single pair FRET and wherein said emitted radiation occurs upon performing single pair FRET.
- 56. The apparatus of any of claims 32-53, wherein said detection system measures a plurality of signals from a plurality of ribosomes.
- 57. The apparatus of claim 56, wherein said computational device performs signal analysis of emitted radiation from said plurality of signals.
- 58. The apparatus of any of claims 32-57, further comprising equipment for identifying at least one protein being synthesized through said analyzing said emitted radiation.
- 59. The apparatus of any of claims 32-28, wherein said detection system operates in real time.
- 60. The apparatus of any of claims 32-59, wherein said detection system monitors protein synthesis by detecting a plurality of protein synthetic processes over a period of time.
- 61. The apparatus of claim 60, wherein said plurality of protein synthetic processes comprise a plurality of interactions of a single ribosome with a plurality of different tRNA molecules.
- 62. A method for analyzing a chemical compound library, said method comprising:

Administering each of the compounds to a protein translation system;

Measuring a response of said system according to the method of any of claims 1-31;

Analyzing said measurement to provide information about said compound.

63. An apparatus for analyzing a chemical compound library, comprising: a well array plate comprising a plurality of wells:

a robot for placing a protein synthesis system into the wells; a robot for administering chemical compounds into said wells; and an apparatus according to any of claims 32-61 to analyze protein synthesis by said system.

64. A method for determining cellular protein pathways, comprising: selecting a cellular or bacterial culture; placing said culture in a plurality of sample containers; subjecting said culture to at least one condition in each of said containers; measuring protein synthesis in each of said containers according to the method of claims 1-31; and

analyzing protein expression patterns in all containers to determine protein pathways.

65. A method for ribosome labeling to allow protein synthesis monitoring, said method comprising:

selecting a fluorescent probe;

selecting a location on at least one of a ribosomal RNA or on a ribosomal protein according to at least one of a characteristic of said probe or a characteristic of at least one of said ribosomal RNA or said ribosomal protein; and

attaching said probe to said location.

66. The method of claim 65, wherein said selecting said fluorescent probe is performed according to at least one of a suitable excitation or emission property of said probe.

67. A method for protein production monitoring, said method comprising: selecting a protein synthesis system for PSM analysis; selecting a fluorescent probe;

selecting a location on at least one of a ribosomal RNA or on a ribosomal protein according to at least one of a characteristic of said probe or a characteristic of at least one of said ribosomal RNA or said ribosomal protein;

attaching said probe to said location to perform PSM; and analyzing signals from said probe to monitor the protein synthesis system.

68. A method for detecting protein synthesis in a protein synthesis system, the method comprising:

providing a marker for protein synthesis in the system, said marker having a label; attaching said marker to at least one component of the system; and detecting said label to determine protein synthesis activity in the system.

- 69. Use of a marker for detecting a protein synthetic act in real time.
- 70. The use of claim 69, wherein said protein synthetic act comprises an interaction between a tRNA and a ribosome.
- 71. The use of claim 70, wherein at least one of said ribosome and said tRNA features a marker.
- 72. The use of claim 71, wherein both said ribosome and said tRNA feature said marker.
- 73. The use of claims 71 or 72, wherein said tRNA comprises a naturally fluorescent amino acid.
 - 74. The use of claims 71 or 72, wherein said ribosome comprises a label.
 - 75. The use of claim 74, wherein said label comprises a quantum dot.

- 76. The use of claim 69, wherein each of said ribosome and said tRNA features a portion of a marker.
- 77. The use of claim 76, wherein a first portion comprises a fluorescent acceptor and a second portion comprises a fluorescent acceptor.
- 78. The use of any of claims 69-77, wherein if said ribosome comprises a marker or a portion thereof, said marker or said portion thereof is covalently or non-covalently bound to ribosomal protein L1, ribosomal protein S1 or a combination thereof.
- 79. The use of any of claims 69-78, for performing a screening assay according to said detecting said protein synthetic act.
- 80. The use of claim 79, wherein said screening assay is for detecting a pathological condition in a subject.
- 81. The use of any of claims 69-78, for pathway elucidation through said detecting said protein synthetic act.
- 82. The use of any of claims 69-78, for cell state analysis through said detecting said protein synthetic act.
 - Use of a marker for identifying a protein being synthesized by a protein synthetic process in real time.
 - Use of a marker for identifying a tRNA species being used in a protein synthetic process in real time.
 - Use of a marker for identifying an amino acid species being used in a protein synthetic process in real time.

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We of a marker for identifying a codon species being used in a protein synthetic process in real time.